

WHAT IS CLAIMED IS:

1. A system for handling substrates held in a carrier, the system comprising:
a robot including an articulated robotic arm;
a processor for controlling the robotic arm;
an end effector attached to a moveable end of the robotic arm, the end effector
5 comprising a blade having a first end and a second end, the blade having an active area
for sensing a distance between the end and the substrate; and
a passive gripper attached to the first end of the blade and an active gripper attached
to the second end of the blade.
2. The system of claim 1 wherein the end effector further comprises a mapping sensor
10 for detecting the mean vertical location of a substrate disposed within the carrier.
3. The system of claim 1 wherein the blade comprises a silicon wafer.
4. The system of claim 1 wherein the blade comprises a ceramic.
5. The system of claim 1 wherein the blade has a thickness less than 1000 microns.
6. The system of claim 1 wherein the blade has a thickness less than 750 microns.
- 15 7. The system of claim 1 wherein the active area is formed on the blade from a
metalization process.
8. The system of claim 1 wherein the active area is adapted to provide at least one of the
mean vertical location, the thickness variation, the bow and warp, tilt, and deviation of
the substrate within the substrate carrier.
- 20 9. The system of claim 1 wherein the active area comprises a measurement transducer.
10. The system of claim 1 wherein the active area comprises a capacitance probe.
11. The system of claim 1 wherein the active area comprises at least one of optical sensor,
pneumatic sensor, inductive sensor, and ultrasonic sensor.

12. The system of claim 1 wherein the active area comprises at least three discrete sensors for providing planar information of the substrate.
13. The system of claim 1 wherein the active gripper is pneumatically actuated.
14. The system of claim 1 wherein the active gripper comprises a servo gripper coupled to a linear motor.
15. The system of claim 13 wherein the active gripper provides feedback to the processor for determining positive engagement with the substrate.
16. The system of claim 13 wherein the active gripper provides feedback to the processor for determining the center of the substrate.
17. The system of claim 1 further comprising a substrate prealigner, the prealigner comprising a prealigner chuck.
18. The system of claim 17 wherein the prealigner chuck comprises a plurality of embattlements for engaging the substrate only along the exclusion zone.
19. The system of claim 17 wherein the prealigner chuck is sized and configured to reduce rotational inertia.
20. The system of claim 19 wherein the prealigner chuck comprises a plurality of holes.
21. A method for handling substrates held in a carrier, the method comprising:
moving a robotic arm across an edge of the substrates;
determining coordinate information of the substrates in the carrier;
storing the coordinate information;
sequentially indexing the robotic arm to the substrates in the carrier according the stored coordinate information;
measuring a distance to the substrate from the arm; and
engaging the substrate with robotic arm.

22. The method of claim 21 wherein the coordinate information includes at least one of mean vertical location, the thickness variation, the bow and warp, tilt and deviation of the substrate within the substrate carrier.
23. A method for handling substrates held in a cassette, the method comprising:
5 providing a robotic arm including a mapping sensor and an end effector including a substrate sensor;
moving the first sensor proximate to the cassette and recording the mean vertical substrate locations;
generating a pick table including mean vertical substrate location data;
10 sequentially indexing the robotic according to the mean vertical substrate locations of the pick table;
engaging the cassette with the end effector;
verifying the substrate position with the second sensor; and
capturing and removing the substrate from the cassette with the robotic arm.
- 15 24. The method of claim 23 wherein the generating of the mean vertical substrate location data is accurate to within 135 microns.
25. The method of claim 23 wherein the recording of the mean vertical substrate location is accurate to within 100 microns.
- 20 26. The method of claim 23 further comprising prealigning the substrate after removing the substrate from the cassette.
27. The method of claim 23 wherein the robotic arm includes an end effector comprising a blade having a first end and a second end, the blade having an active area for sensing a distance between the end effector and the substrate.
- 25 28. The method of claim 23 wherein end effector includes a passive gripper attached to the first end of the blade and an active gripper attached to the second end of the blade.
29. A robotic end effector for holding a substrate, the end effector comprising:
a mapping sensor for detecting a mean vertical location of a substrate;

a blade having a first end and a second end;
an active area for sensing a distance between the end and the substrate located along
the blade; and
a passive gripper attached to the first end of the blade and an active gripper attached
5 to the second end of the blade.

30. The robotic end effector of claim 29 wherein the active area is formed from a
metalization process.

31. The robotic end effector of claim 29 wherein the end effector includes a sensor for
detecting the mean vertical location of a substrate.

10 32. The robotic end effector of claim 29 wherein the active area comprises at least three
discrete sensors for providing planar information of the substrate.

33. The robotic end effector of claim 29 wherein the active area is adapted to provide at
least one of the mean vertical location, the thickness variation, the bow and warp, tilt, and
deviation of the substrate within the substrate carrier.

15 34. The robotic end effector of claim 29 wherein the active area comprises a
measurement transducer.

35. The robotic end effector of claim 29 wherein the active area comprises a capacitance
probe.

20 36. The robotic end effector of claim 29 wherein the active area comprises at least one of
optical sensor, pneumatic sensor, inductive sensor, and ultrasonic sensor.

37. The robotic end effector of claim 29 further comprises a mapping sensor for detecting
the mean vertical location of a substrate.

38. The robotic end effector of claim 35 wherein the mapping sensor comprises a laser
transducer.

25 39. The robotic end effector of claim 29 wherein the blade comprises a silicon wafer.

40. The robotic end effector of claim 29 wherein the blade comprises a ceramic substrate.

41. The robotic end effector of claim 29 wherein the blade has a thickness less than 1000 microns.

42. The robotic end effector of claim 29 wherein the blade has a thickness less than 750 microns.

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